Space Weather Technical Forecast

Issued on Thursday 27 February 2025 at 12:41 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Isolated M-class flares likely. Chance of further G1 Minor Storms, most likely days 1 and 2 (27-28 Feb).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Low with occasional C-class flares. There are currently ten sunspot regions on the Earth-facing disc. Most regions have generally been showing a simplifying and weakening trend, or have been stable. The most likely flare source is AR3998 in the southwest, which is the largest region on the disc, however this region is expected to rotate over the southwest limb day 2 (28 Feb), reducing the flare probabilities. The next most complex is AR4006 in the northeast, with some mixing of polarities through its intermediate spots, however this has remained stable and relatively inactive. The other regions are much smaller and simpler.

A filament eruption in the southwest was observed around 26/1445 UTC. This has been analysed and is considered most likely to pass ahead of Earth but a glance can not be completely ruled out. Also, a filament in the southeast saw some ribbon flaring on the edge of CH19/+, this is believed to pass behind Earth's orbit. A filament eruption in the northern hemisphere around 27/0500UTC appears to have been re-absorbed.

Solar Wind / Geomagnetic Activity: The solar wind, as measured by ACE/DSCOVR at L1, appears to have connected with the High Speed Stream from CH19/+ a little earlier than expected with speeds becoming elevated between 500km/s and 600km/s. Density was often above average 15 to 20ppccm. Interplanetary Magnetic Field, Bt, initially Strong at 17nT around 26/1200 UTC. This dropped back to Moderate levels by 26/1300 UTC where it has remained. The north-south component was largely variable with a minimum of -12nT at 26/2202 UTC and a peak of +16nT at 26/1200 UTC. Phi angle was positive (away from the Sun). Geomagnetic activity was Quiet to Unsettled (Kp 2-3) with an Active (Kp4) interval between 27/0001-0300UTC and a G2/Kp6 Moderate geomagnetic storm between 27/0900-1200UTC.

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV) at GOES18 was above background, but below the the S1/Minor Radiation and declining. The 24-hour fluence was below the Active threshold (1e8 integrated pfu), recording 1.13e6 integrated pfu at 27/0000UTC.

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Space Weather Technical Forecast

Four-Day Space Weather Forecast Summary

Solar Activity: Low to Moderate activity is forecast with isolated M-class flares likely at first, reducing to a chance of isolated M-class flares by day 3 (01 Mar).

Solar Wind / Geomagnetic Activity: Glancing CME influences are currently not expected, but can't be completely ruled out days 1-2 (27-28 Feb) from the filament eruptions 26/0600UTC and 26/1445 UTC. Further enhancement from CH19/+ is likely on days 1-2 (27-28 Feb), with Strong wind speeds of over 600km/s expected. Wind speeds are likely to remain elevated or strong for the rest of the period. Unsettled to Active geomagnetic activity is expected with a chance of further G1 Minor geomagnetic storms on Days 1-2 (27-28 Feb). From Day 3 (1st March) geomagnetic activity is expected to return to predominantly Quiet though with winds remaining elevated there remains a likelihood of further Unsettled to Active intervals and a small chance of Minor geomagnetic storms.

Energetic Particles / Solar Radiation: High energy proton flux is currently below the S1 Minor Storm level, and is expected to continue declining towards background, with only a slight chance of further enhancements. High energy electron flux is expected to be at background. The associated 24 hour fluence is expected to remain below the Active (1e8 integrated pfu) threshold.

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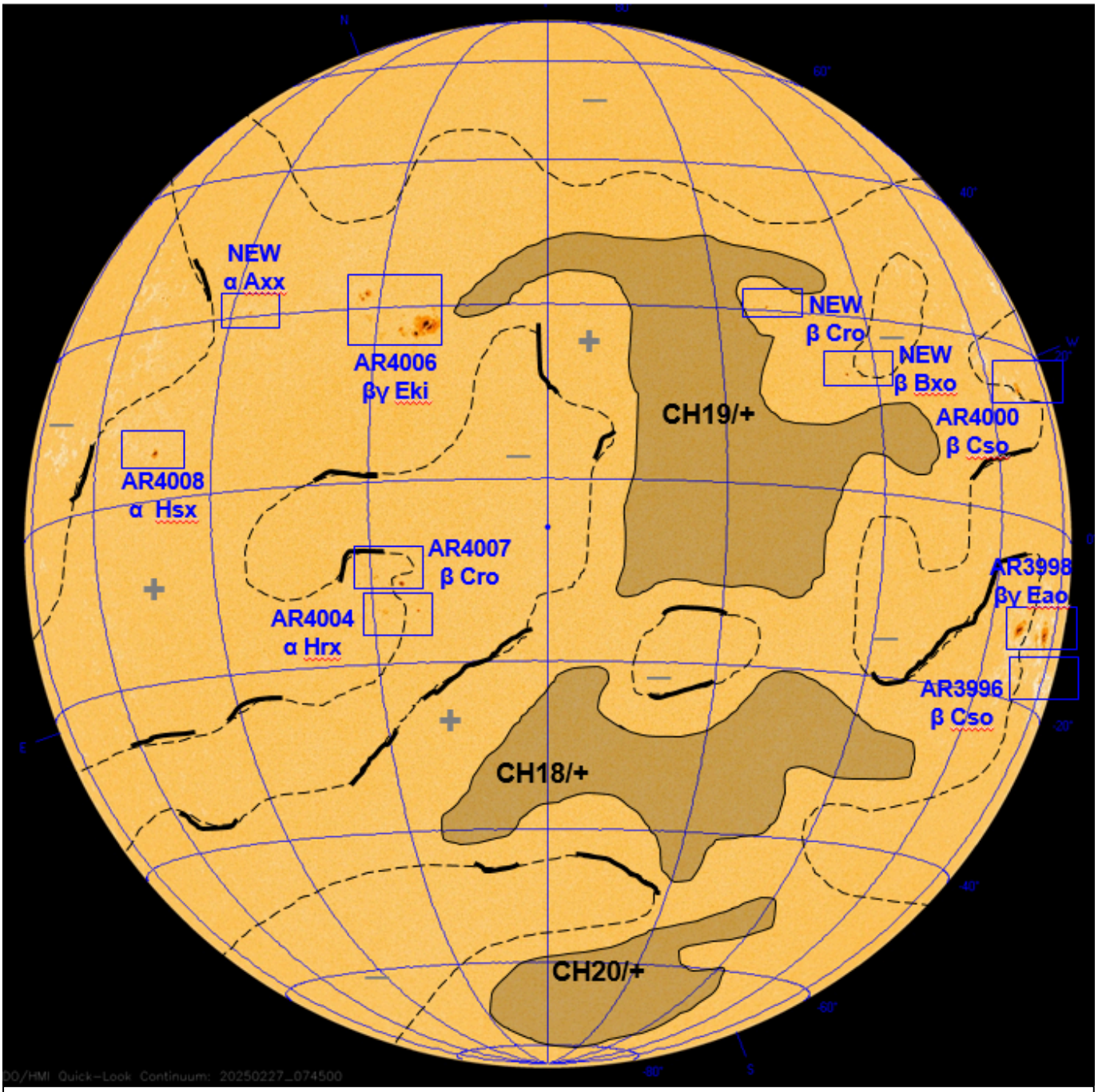
Figure 1: Solar Synoptic Analysis 27/0800UTC



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms

A fast and bright CME off the northwest on 24 Feb obscures a much weaker and fainter signal from the M3.3 flare and associated filament eruption. This signal is identifiable on STEREO A cor2 difference imagery, and this is likely missing north and ahead of Earth's orbit. However, due to the contamination from the far-side event, this assessment is low confidence, and a glancing influence cannot be completely ruled out, most likely to occur during Day 1-2 (27-28 Feb). The second filament eruption was observed from the centre disc around 26/0600 UTC, from analysis this looks to pass ahead of Earths orbit, with a slight chance of a glancing blow during day 2 (28 Feb). Later on the 26 Feb, around 26/1445 UTC a filament lifted from the southwest disc, which again looks most likely to pass ahead of Earths orbit with a slight chance of a glancing blow later on day 2 and into day 3 (28 Feb- 01 Mar). Also, a filament in the southeast lifted off around 26/1640 UTC with some ribbon flaring close to the edge of CH19/+. From analysis this looks most likely to pass behind Earth. A filament eruption in the north around 27/0500UTC appears to have been reabsorbed.

Solar winds at Earth are currently Elevated, due to a likely earlier than expected connection with CH19/+. As CH19/+ is a persistent feature, solar wind speeds are expected to reach 650-700km/s. While the speeds are expected to increase, geomagnetic activity is likely to be subdued due to the closeness to the spring equinox and the positive polarity of the CH. This is supported by 27-day persistence, with MOSWOC Enlil perhaps too early to connect to the fastest winds but still indicative of the expected strength once this occurs.

Generally Unsettled to Active geomagnetic activity is expected with a chance of further G1/G2 Minor/Moderate geomagnetic storms on Days 1-2 (27-28 Feb). From Day 3 (1st March) geomagnetic activity is expected to return to predominantly Quiet though with winds remaining elevated there remains a likelihood of further Unsettled to Active intervals and a small chance of Minor geomagnetic storms.

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	**G1 to G2**	Yes	40	25	15	10
Strong	**G3**	No	5	1	1	1
Severe	**G4**	No	1	1	1	1
Extreme	**G5**	No	1	1	1	1

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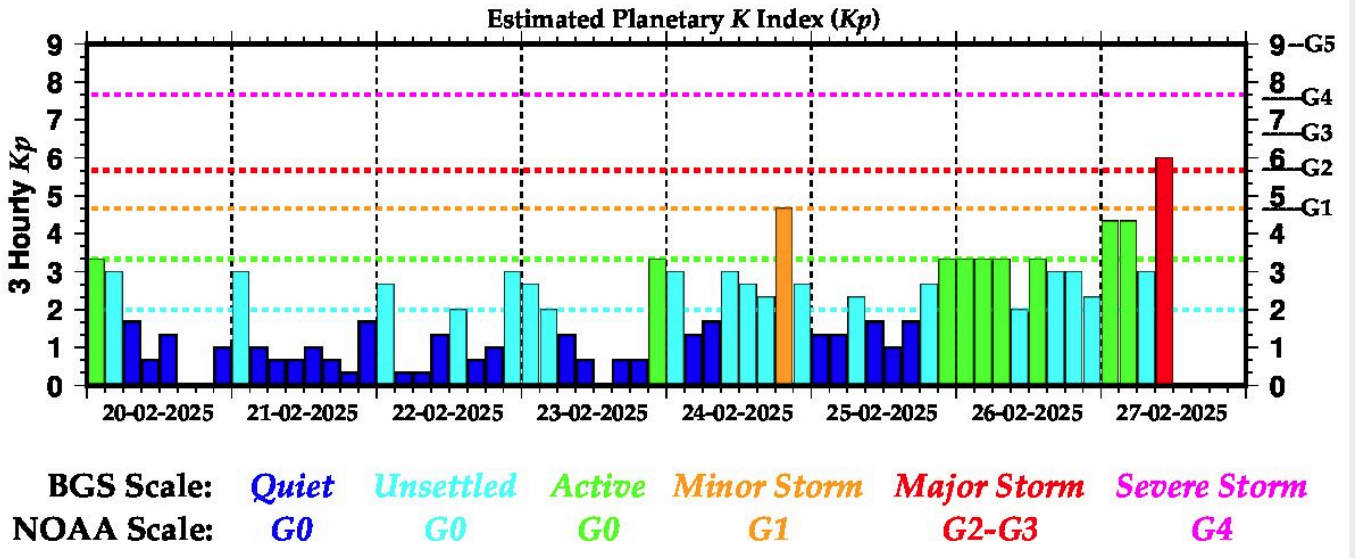
Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R⊙ (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed (km/s)	Estimated Arrival Time (UTC)	Comments
24/1414	Partial	AR4000 and filament	NW	448	27/1800 UTC +/-12 hrs	Low confidence. Glancing impact possible, but not expected.
26/1847	Partial	Filament	SW	945	28/2100 +/-12 hrs	Low confidence. Glancing blow but not expected.

Figure 2: Estimated Planetary K Index (Kp) from BGS



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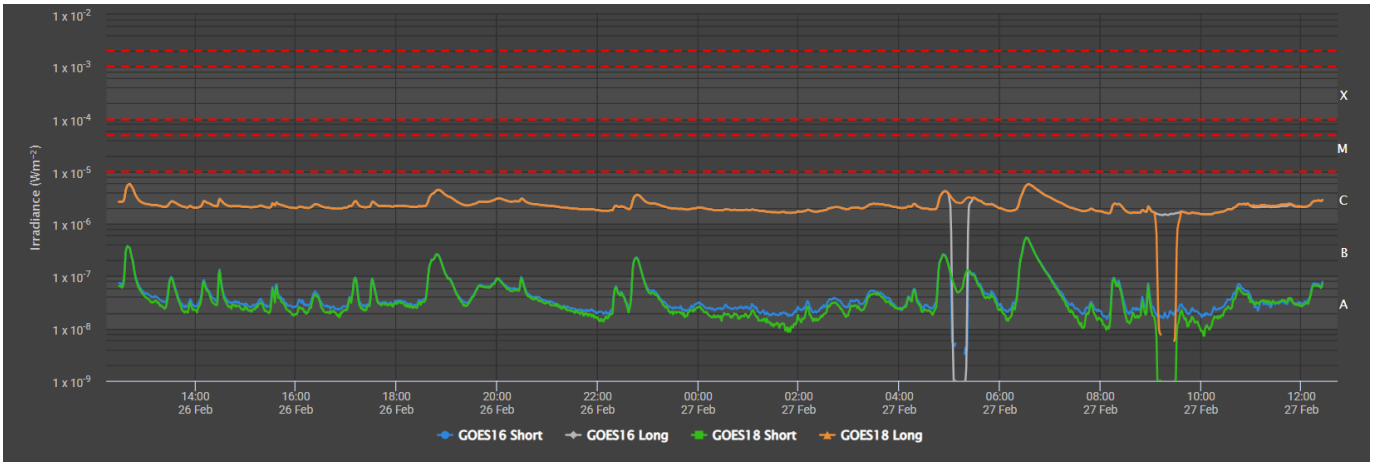
Radio Blackouts - X-Ray Flares

Low to Moderate activity is forecast with isolated M-class flares likely at first, reducing to a chance of isolated M-class flares by day 3 (01 Mar).

There are ten sunspot regions on the Earth-facing disc. AR3998 in the southwest and AR4006 in the northeast are the most complex sunspot regions on the disc at present, although both are relatively stable and in recent imagery showing some slight signs of decay in their respective intermediate portions. Three new, unnumbered regions have developed in the northern hemisphere, these are small simple regions at the moment. Otherwise, the rest of the spots are all magnetically simple and stable.

X-Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 (M Class)	No	55	55	50	50
Very Active	R3-R5 (X Class)	No	5	5	1	1

Figure 3: XRay Flux from GOES18



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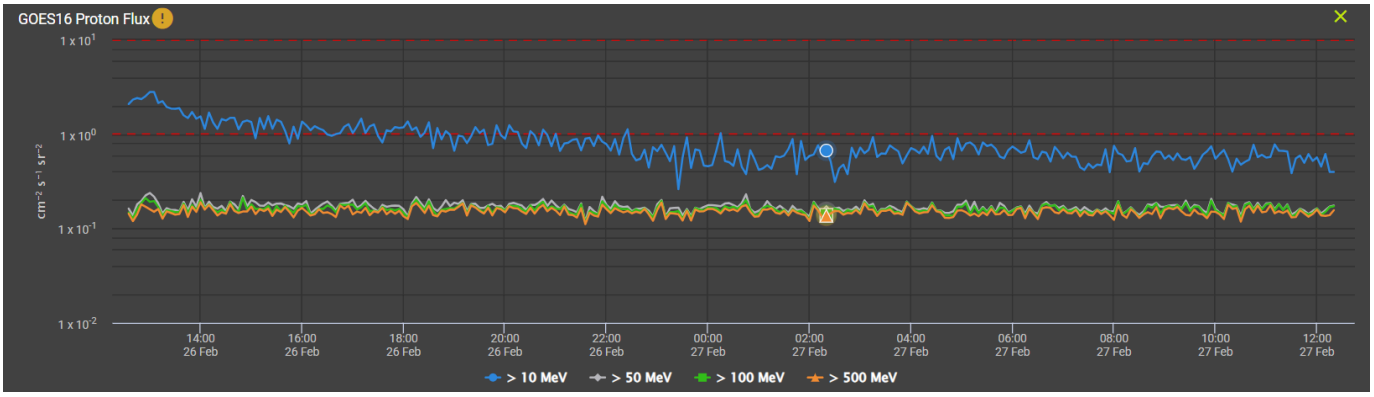
Solar Radiation Storms (High Energy Protons)

GOES-18 high energy (>10MeV) proton flux has been declining after the S1 Minor Radiation Storm that occurred on 25 Feb, and remains slightly above background. This was due to large eruption from over the southwestern limb, however any further enhancement from this source is now less likely as this moves further onto the far-side. The most likely source of any enhancement would be any further flares from AR3998 in the southwest, with an increasing potential from AR4006 as this moves towards and into the western hemisphere.

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	10	10	10	10
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 4: GOES16 Proton Flux



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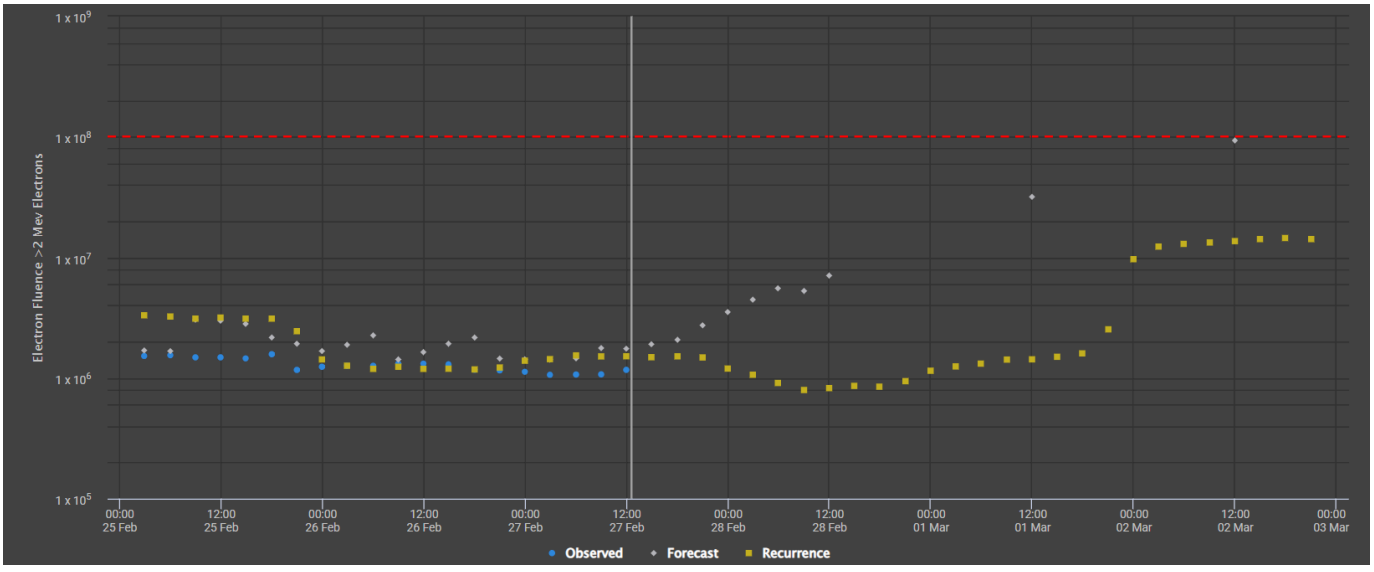
High Energy Electrons (≥ 2MeV)

The high energy electron flux (>2MeV), as observed at GOES-16 is at background. While the upcoming fast wind from CH19 (and perhaps CH18) has the potential to increase electron flux in the Van Allen belts later in the period, any response at GEO is expected to occur after the end of this forecast period.

The associated 24 hour fluence is currently below Active. This is expected to continue as suggested by MOSWOC REFM, which is currently providing reasonable guidance.

GEO Electron Environment	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ 1×10^{8}	No	1	1	1	5
Very Active	≥ 2 MeV ≥ 1×10^{9}	No	1	1	1	1

Figure 5: MOSWOC REF Model



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